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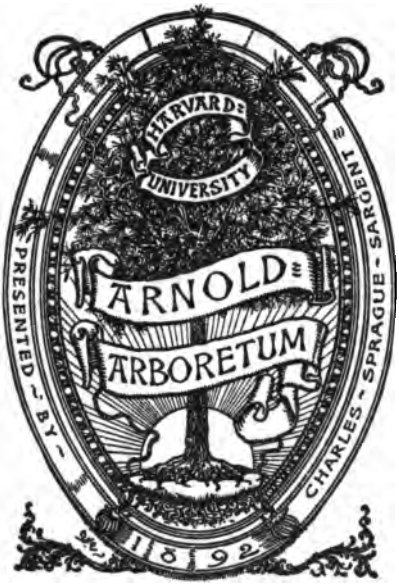

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THE UNIVERSITY RECORDS SERIES 1. NO. 3. PART 4

CORNELL UNIVERSITY

Progress of Forest Management in the Adirondacks

NEW YORK STATE COLLEGE OF FORESTRY

ANNUAL REPORT OF THE DIRECTOR

1900

ITHACA, NEW YORK
PUBLISHED BY THE UNIVERSITY
MARCH, 1901
BI-MONTHLY

ENTERED AT THE POST OFFICE AT ITHACA, N. Y., AS SECOND CLASS MATTER.

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NEW YORK STATE COLLEGE OF FORESTRY.

CORNELL UNIVERSITY.

B. E. FERNOW, *Director.*

BULLETIN 3. MARCH, 1901.

Progress of Forest Management

IN THE

Adirondacks.

Third Annual Report of the Director of the New York
State College of Forestry,

ITHACA, N. Y.

May 1915
30203

PRESS OF
ANDRUS & CHURCH,
ITHACA, N. Y.

REPORT OF THE DIRECTOR OF THE NEW YORK STATE COLLEGE OF FORESTRY.

NEW YORK STATE COLLEGE OF FORESTRY,
CORNELL UNIVERSITY, ITHACA, N. Y., *January 15, 1901.*

To the President of the University:

SIR—I have the honor to submit herewith, as Director, my third annual report on the operations of the New York State College of Forestry for your approval and transmission to the Legislature under the provisions of Section 122 of the Laws of 1898, establishing this College.

I may state at the outset that both the College and the operations in the College Forest have, during this, the second full year of their existence, experienced satisfactory progress, if increase in numbers of students in the first and development of the proposed management in the latter with the expectation of making it self-supporting from the start may be recognized as such progress.

STUDENTS, TEACHING FORCE AND COURSES.

During the year the first graduate of this College—the first graduate from any professional forestry school on this continent—has gone out and found ready employment with the New York State Forest, Fish and Game Commission. In addition, four special students, graduates of other colleges, who had spent one year in pursuing forestry courses, left the College, three of whom found employment with the Federal Forestry Division and one with a lumberman's firm. One most promising student in the freshman year was accidentally drowned during the summer, another was prevented from returning by business considerations, so that, at the beginning of the term, only ten of the seventeen students regularly inscribed during the previous college year returned.

This number has been increased to date by new registrations to twenty-five, as follows:

5	seniors,
2	juniors,
6	sophomores,
5	freshmen,
4	specials,
3	post graduates.

Of these, fifteen, coming from the State of New York, receive their tuition free of charge; the tuition fees of seven in freshman and sophomore courses, and post graduates taking forestry as a minor—their instruction being mainly furnished by the University—goes to the University Treasurer, and the fees of three in the junior and senior years of the College. Maine, Connecticut, Pennsylvania, Michigan, Minnesota, Missouri, California and Russia are represented besides New York. Two of the post graduates are taking forestry as their minor subject for the degree of Doctor of Philosophy; the third, holds this degree from Johns Hopkins University.

In addition to these regularly inscribed students, there are registered for certain courses 29 students from other departments, namely, from the Colleges of Architecture, of Civil Engineering and of Agriculture; the registrations in all the courses during the fall term just past having been 76, by 54 students.

No changes have taken place in the faculty during the year, but provision has been made for additional lecturers on special subjects.

Dr. B. W. Evermann, of the United States Fish Commission, gave, during the spring term at Axton, the first course of twelve lectures on Fish Culture, three visitors attending besides the eight junior and senior students. The course proved of such practical interest and the lecturer so admirably fitted not only for presenting the subject in the class-room, but for introducing the students to field observations, that it is proposed not only to repeat the course, but to have Dr. Evermann also take charge of the course on Game Preservation.

In order to secure the preparatory course on morphology and classification of fishes, birds and mammals by the zoological department, the College, this year, pays half the salary of the instructor, Mr. H. D. Reed.

A short course in practical timber estimating under the direction of Mr. C. P. Whitney, a well known estimator, was also given in Axton, and will be repeated every season.

During the present year, a short course on "Marketing the Forest Crop," will be given by Mr. W. H. Wetmore, of New York, in which the business principles and methods applying in the lumber trade are to be discussed. Mr. Wetmore brings to his task an experience of more than sixteen years in various positions.

By another year, it is hoped that two additional very desirable courses may be established in coöperation with departments of the University, namely, a course in law and a course in engineering. Foresters are to become neither lawyers nor engineers, but as competent managers of forest properties, they cannot dispense with a certain amount of knowledge both as to the principles of law and as to certain selected portions of engineering. Such knowledge is usually acquired at the expense of the employer and by attrition in actual practice—an expensive process—but a rational scheme of education should at least provide a stable basis upon which to accumulate such knowledge.

It is evident that the most common principles of property rights, real estate law and methods of trespass, and of contract and business law should be known to anyone entrusted with the management of a piece of property, enough, at least, to avoid the common mistakes which lead to unnecessary litigation. Such a course, selected not for professional lawyers, but for the needs of educated business men, would, indeed, be a most desirable addition to the curriculum of any student who expects, as the majority in these days do, to be employed in business

A large part of the forester's business is concerned in the harvesting of his crop. The presumption is that foresters will be lumbermen, or lumbermen become foresters; and all that a lumberman knows or can do must become the property of the forester in moving the crop. To move this bulky crop most expeditiously and cheaply, no mean amount of engineering skill must be developed, and especially since cheapness is of more moment than excellence of structure, special attention in that direction is necessary. He should learn how to locate and construct cheap roads, cheap railroads, cheap dams and water ways and log slides; how to dispose of labor and materials so as to secure the quickest and most effective results. Again, this may finally and fully be learned only in practice, but since so much of the financial success of a forest manager depends on this part of his performance, it is rational to give him at least the basis upon which to start. The regular engineering courses, having other ends in view, are necessarily too full for the needs of a forester, hence a special course needs to be devised.

Practical Instruction in the Forest.

The policy of transferring the junior and senior classes for practical work to the College Forest during the spring term has proved an admirable one. The expected benefit to the students of direct contact with the woods under competent direction, in spite of the somewhat crude conditions at first encountered, has been fully realized. The season opened unusually late, three feet of soft snow covering the ground and making the woods inaccessible when the term opened; unfortunately, the library which was to be established at Axton was also late in arriving, and the accommodations were somewhat primitive. All of these difficulties have been overcome for the present year.

Although the College building which it was expected to erect at Axton has, for business reasons, not been built, by remodeling existing buildings a suitable lecture and reading room has been secured, and the boarding house facilities have been improved A good library has been established, containing a sufficient selection of books of reference and of professional character.

The transfer of the classes will, under the new arrangement of dividing the college year into two semesters, not take place until after the Easter holidays, two weeks later than last year, when it is expected the woods will be more accessible. Practical forestry operations are now fully established in the College Forest and the opportunity for participating in them and observing them are therefore increased.

The time, during last spring, was occupied with field work in addition to the lectures on forest mensuration, forest protection, fish culture and game preservation, about as follows:

Inspection of logging operations	9	days,
Timber estimating and measuring	12	"
Surveying, and locating roads	10	"
Nursery work and planting	4	"
Marking trees for cutting	2	"
Practical work in sugar orchard	3	"
Excursions to fishing grounds and hatchery	4	"

Accommodations.

There is no greater need for the proper conduct of this College than sufficient accommodations. The same language which I used in my last report still fully applies to present conditions. It was as follows.

"Considering the crowded condition of the University, in many if not all of its departments, even this insufficient and unsatisfactory housing of this State institution must be gratefully accepted as real generosity, for which the University secures but small return from the prestige of administering the College.

"I can only repeat with more emphasis that 'the absence of convenient and permanent lecture and laboratory rooms retards the proper development of the College and is discouraging both to students and professors.'

"An adequate building, worthy of an institution which the great Empire State sees fit to maintain, is the foremost requirement now, since the College is otherwise fairly established."

While it is possible to arrange for lectures in unoccupied rooms of the University by choosing inconvenient hours, and to eke out laboratory facilities by dividing classes and lengthening the hours of professors, the greatest drawback which comes from the absence of permanent quarters is the impossibility of installing that most important tool of a modern educational institution, demonstration material. Collected and placed in a storage room, such material becomes inaccessible and impractical for daily use, and its collection is naturally postponed until opportunity to care for it and use it may be furnished.

THE COLLEGE FOREST.

There seems still to linger among a large class of people the idea that forestry consists in preventing lumbermen from cutting trees. These good people forget that our civilization is largely built of wood and that trees must be cut to furnish the necessary material. It would be possible, though, in most cases, foolish and undesirable, to set aside portions where, for some reason, the forest should be left undisturbed; in such cases of let-alone policy, no forestry, *i. e.*, application of knowledge and skill in reproducing forest crops and keeping up the forest production, is needed; nature and proper police forces will take care of such areas.

The forester is a harvester as well as a grower of a crop; he preserves the forest as the human race and all life is preserved, by removal of the old, and reproduction. In this last activity only, or mainly, does he differ from the lumberman, namely, in that he is bound to reproduce, not necessarily the kind of crop that nature planted, but one that is economically most desirable. He may secure this reproduction either by gradually removing the old crop, relying on seeds falling from, and seedlings developing under the mother trees left on the area—natural regeneration—or else he may remove the old crop at once and replant the cut-over area—artificial reforestation—or he may combine the two methods in a variety of ways. Which method is preferable depends upon many considerations, but mainly on financial ones.

In any case, the old crop must be removed, to make room for the new crop, and, of course, the old crop should be utilized to its fullest extent.

Silvicultural and commercial considerations and policies, then, influence forestry as a business, and the College Forest, in so far as it has been dedicated to a demonstration of the business management of a forest property, must be managed according to such pre-determined silvicultural and commercial policies as I have outlined in my last report, whatever differences in detail of execution experience or judgment may dictate.

The appropriation of a working fund and the enactment of legislation (Laws of 1900, Chapter 419) by which the income from the management of the College Forest is turned into a separate fund, continuously available for the purposes of the forest management, has rendered possible the inauguration of the commercial policy intimated as desirable in my last report.

With this legislation, which makes the management independent of uncertain annual appropriations, it became practicable to enter into contracts under which the entire harvest of old hardwoods from the forest could be disposed of, factories could be established for its utilization, and means of transportation developed.

Insufficient Working Capital.

Unfortunately the working capital, for which fifty thousand dollars had been asked, was cut down by the Legislature to thirty thousand dollars, barely sufficient to carry on the logging operations, and hampering the satisfactory development both of the business of harvesting and of the silvicultural operations. Every business man will understand that there is needful a certain minimum amount of working capital which, in a given business, furnishes the most satisfactory results. If the amount is below this figure it may still be possible to carry on the business, but not to the same advantage. So it is with the forestry business.

It would have been desirable to invest at the outset a considerable amount in constructing more or less permanent means of transportation, developing, under a well-devised plan, a system of roads or movable railroads, in order to make the different parts of the property accessible. The advantage of making a larger area accessible at once lies in the fact that the cutting can then be distributed over a larger area, or, in other words, the same area may be cut over more gradually through a number of years. Such *gradual* removal of the old crop is the most advantageous in securing a young crop by natural reproduction, since a sufficient number of seed trees may be left which, by their partial shade, benefit the young seedlings at first, and then may be gradually removed by repeated returns to the same area. Other advantages known to the forester, especially the avoidance of suddenly opening old stands to the winds, whereby damage from windfalls is invited, and of increasing fire danger in large areas of uniform young growth come from such distribution of the felling areas.

With the limited financial means at command, the management has been forced, this first year, to concentrate its logging operations to one locality, to remove at once a larger proportion of the old crop than is desirable from silvicultural points of view, and to rely on artificial reproduction, except in so far as a desirable volunteer crop was already in existence and could be saved. These financial limitations, therefore, must be kept in view to explain methods of procedure which otherwise might have been modified; the aim of the management having been, above all other considerations, to avoid the necessity of further appropriations, and to place the operations on a business basis at once without entrenching on the working capital. This object, namely, of making the experiment at least self-supporting from the start, promises at present writing to be fulfilled, in spite of many other drawbacks, among which should be mentioned a most unusually unfavorable winter for logging. Considering that the property consists of a culled forest, *i. e.*, one from which the lumberman has removed all that he considered valuable and saleable, the pine and spruce, such a showing, if accomplished, would be a creditable enough beginning.

Whether it was wise policy to circumscribe an experiment of this kind, conducted under State auspices, and in this way to bring it down to the cramped and anxious position of a business venture, is perhaps open to discussion; the evident object of the demonstration contemplated by the State being to furnish evidence of the practicability—or impracticability—of profitable forest management. *i. e.*, harvesting and renewing the crop, it was perhaps well to start it under inauspicious conditions, for such financial limitations are, after all, of a practical character, constantly occurring and influencing forest management. They accentuate the fact that many things which, from a technical point of view and ideally, as taught in the class-room or devised in an office, are most desirable, may not be put into practice when business considerations place a limit on expenditures.

The Contract.

As has been pointed out again and again, the first concern of the forest manager is to find a market for his old crop, and this, with the old, decrepit hardwoods which form the bulk of the culled forest, such as the College Forest, means not only a market for the merchantable logs, but for the cordwood, which, in bulk, exceeds the logs two or three times.

Such market did not exist within the reach of the College Forest; it had to be created. A contract has, therefore, been entered into with the Brooklyn Cooperage Company, Lowell M. Palmer, President, under which the Cooperage Company is erecting at Tupper Lake a stave and heading factory to utilize the logs, and a wood alcohol plant to use the cordwood; building and operating a railroad from their plants into the forest, to transport the raw material out of it, the College building only such spurs or sidings as appear desirable to reduce the hauling distance. The contract calls for the delivery of the hardwood crop, such as under forest management it becomes necessary to remove, to be delivered to rail in fifteen yearly instalments, which may possibly be lengthened to twenty years, including also such softwoods as may be cut, fit for headings.

From present estimates, this involves the annual harvest of from ten thousand to twenty thousand cords of retort and fuel wood and two million to four million feet of logs. The logs are to be cut down to eight inch diameter and in lengths of thirty-two inches or multiples thereof (stave bolts), measured by Scribner's rule, (which with the sizes usual in the Adirondacks, allows 16 per cent. more material than the customary Doyle rule); the cordwood is taken down to branch wood of three inches diameter, the billet lengths being fifty inches. In this way, almost all the material in a tree when felled is utilized, the brushwood only remaining. An attempt has been made to turn this, too, to use by bundling it for cheaper handling, and to employ it in several ways, namely for wood alcohol distillation or in charcoal making, brickkilns or limekilns.

The prices obtained are fair market rates and more favorable than the owners of a property of eighty thousand acres more or less, as favorably situated in the Adirondacks, have this same year been satisfied to accept for logs, without disposing of the cordwood.

Financially, it may be argued, that the contracting away of stumpage at present market prices for fifteen years is unsound, as a rise in value is likely to occur. Such rise, to be sure, is not likely to occur in cordwood which is actually the more important item, whether considered in its gross or net amount. For spruce and other softwoods the contract price runs only for seven years, then to be readjusted according to prevailing market rates. A private owner, managing his own property for what he can make out of it, could very well take the risks and advantages of a varying market, such as a public institution, from which a continuity of performance as a demonstration is expected, could not take. This practical consideration alone made it desirable to settle the market question, for the bulk of the crop at least, at once for the entire period of the management of the College Forest, even at a possible financial disadvantage. Moreover, to secure a market where none existed at all could only be accomplished by offering sufficient inducements for manufacturers to establish their costly plants.

First Logging Operations.

The final contract was concluded in July, with the location of the factories at Tupper Lake. The laying out of the railroad was at once begun by the manufacturer, and the construction of somewhat over four miles was completed by December 15th. A spur of somewhat over one and one-quarter miles was built by the College, and has been finished, all but the laying of rails, which was prevented by the delay in the construction of the main line and by the unusual snowfall in December. It is, however, expected to have the road in operation in early spring for hauling logs to the stave factory, now being built, and transporting cordwood to the alcohol distillery, and other materials to market.

Logging operations were begun early in July, at first confined to a sample cutting to gain an insight into methods and results. This sample cutting, which had been planned for an earlier date, but was delayed, owing to an unfavorable season and for other reasons, is of sufficient interest to deserve further discussion later in this report. By the 15th of September, logging was in full operation, with a crew varying from thirty to sixty men. At present a crew of 80 men, in addition to the cordwood cutters are at work.

Owing to the long, open fall season and the consequent continuance of work in mills, labor for the woods was scarce in the beginning of the felling season, and the unusual heavy snowfall in December upon unfrozen ground, such as has not been known for the last nine years at least, has impeded the work greatly.

The cordwood is being cut by a contractor, but the felling of trees, cutting and skidding of logs is done on our own account. This course was pursued because the care which it is necessary to apply in felling trees, so as to save the young volunteer growth of spruce could not have been secured from a contractor, no matter what rules and regulations might be prescribed and supervision exercised. Such care involves expense and the contractor, whose interest is only financial, is naturally averse to exercising it conscientiously. On the other hand, pride in the achievement and interest in the result stimulates a good foreman to exercise constant vigilance and judgment, and his crew to understand the objects of the care and to help secure them. The College management has been successful in securing the services of such a foreman and crew. While such logging with care is more expensive than the rough and tumble slashing without care for future condition of the ground, the cost of it promises to remain within the limits which responsible contractors had set, including their profits. Another argument for preferring, for the present at least, the day work under a good foreman is that forestry work of various kinds beside logging is to be done, and requires skilled labor, and hence it is desirable to have a permanent crew throughout the year and from year to year, especially where, as in the Adirondacks, no local labor can be relied upon. The contract system, while much more convenient from the administrative point of view, is not satisfactory where care and interest in the work is needed.

The financial limitations pointed out before have necessitated concentration of the logging operation, which will require the cutting over of five hundred to six hundred acres. The trees to be cut are marked by the forest manager and his assistants. Various degrees of severity in the cut were attempted, special consideration being given to the existence of young spruce growth. The first area attacked (compartments K 4, 5 and 6) had been swept by fire some years before, by which not only all the youngest spruces had been killed, but many of the younger hardwood trees had been injured to such an extent that they could not be expected to grow into good trees. Here only a small number of trees are left, and resort to artificial reforestation is necessary. In other parts a larger proportion of hardwood trees have been left with the spruce, so as to reduce the need of artificial help. It is expected that about fifty per cent. of the area cut over this year will have to be planted. Such planting will be done mainly with White Pine and Norway Spruce, using both plants and seeds, and adding elm and ash together with a few other species. Other methods of cutting, like the strip method, are also contemplated as soon as the question of economic transportation from a larger territory, which will permit distribution of felling areas, is solved.

One of the expected results of the severe opening this year, namely damage from windfall to the left-over trees, was experienced at once ; a number of the few old trees—not many were left—and of the taller polewood were thrown in two severe gales. One of these gales was a most unusual tornado (December 2), which broke and threw timber in the dense forest as well as in the cut areas, so that this year's experience is not an entirely satisfactory demonstration as to the number and sizes of trees that may be expected to be thrown when so exposed. Another loss, which must be expected and will this year, with the wet December snow, be more severe than ordinarily, is that from snow pressure, which has broken many trees both in the dense forest and in the open.

The cordwood cutter works up most of the debris, yet there is still a large amount left, which it is desirable to get rid of. It is still hoped to reduce this waste by marketing the brush down to one inch diameter, when the rest may be left to rot. Otherwise burning may become necessary, to avoid danger from fire and permit planting with ease. A trial made in burning brush in the fall season proved altogether too expensive. This burning should be done when the snow is on the ground in early winter or spring. The heavy snows in this direction, too, were a hindrance.

Forest Fires.

The first summer, 1899, was full of trouble with forest fires—it was the driest summer known in twelve years—the summer of 1900 had no such terrors, having been the wettest for six years.

During the preceding winter, fire lines were opened along the west and east boundaries of the Wawbeek district to a width of two rods. Such fire lines, however, to be effective, must be properly cleared and sowed to grass, and then kept in proper condition. All this entails expense, and finally these openings offer only a basis for defence against a fire under headway. While their usefulness may not be denied, the probability is that the same expenditure for watchmen during the dangerous season will secure greater immunity or protection, especially in a district in which such watchmen can be occupied on other work when not engaged in watching. These fire lines will be put in proper shape for demonstration mainly.

With the logging operations, especially in concentrated location, the danger from fires necessarily grows, and only care in keeping out fire and people, careless with fire—constant watchfulness—promises success.

A SAMPLE FELLING—YIELD OF ADIRONDACK HARDWOODS.

An investigation of practical interest to every hardwood logger in the Adirondacks was made in connection with a sample felling. For this purpose twenty-six acres were selected, representing average conditions of hardwood forest, from which the pine and spruce had been culled previously, situated on a gentle slope with southern aspect. The area had served the purpose of a thesis for graduation of one of the students of the College and to that end the timber had been both carefully estimated and measured, and the trees to be cut had been marked under instructions to remove all trees over twelve inches diameter unless clearly needed for seed trees.

The tract was afterward cut without reference to this restriction and to the marking, as it was found that most of the trees left were damaged by previous fires and rotting; so that a larger number of these was taken and the final result was an almost entire removal of the hardwoods, only the spruce polewood and younger trees and some sound hardwood trees being saved as far as practicable.

The composition of the stand will appear from the subjoined table.

COMPOSITION OF A CULLED FOREST.

	Trees over 12 in. diam				Young trees.			
	Number.		Percent.		8 to 12 in.		4 to 8 in.	
	Total	per acre.	No.	Vol.	No.	%	No.	%
Maple	702	27	40	48	105	15	153	20
Birch	382	15	22	26	43	6	82	10
Beech	198	7	11	8	103	14	83	10
Hemlock	208	8	12	7	78	11	225	29
Spruce	155	6	9	5	211	28	137	18
Balsam*	75	3	4.5	2.5	122	17	78	10
Pine	6	1	1.5	3.5	9	1	3	—
Poplar*	10				38	5	16	3
Cherry	8				9	2	2	—
Ash	2				—	—	—	—
	1,746	67			718 (28 p. acre)		778 (30 p. acre)	

*From a small strip of lowland.

It will be seen that the whole forest is poorly stocked, especially in younger trees. The polewood is but poorly represented and seedlings or trees of the thicket stage are almost entirely absent; especially the younger hardwoods are not abundant and in most cases defective, damaged by surface fires and decay having started at the base of the trees where they had been scorched. The young birch was found more sound and better developed than either maple or beech.

The three prominent hardwood trees, beech, birch and maple, appear in the composition approximately in the proportion of 1 : 2 : 4, and furnish also logs in nearly that proportion, but in contents the relation becomes 1 : 3 : 5, the birch furnishing for the same number of trees and logs a larger output, *i. e.*, larger sizes, and it may be added sounder material.

This statement as to sizes is further borne out by the subjoined table which gives the distribution of the trees among the diameter classes, from which it appears that the largest diameters are found in the birch, and that a larger total number over twenty inches is found among them than of maple, although the total of all sizes is much smaller. It also shows that nearly half the maples are in the twelve and fourteen inch class, and that altogether nearly three-quarters of the trees fall within the diameter limits of twelve to fourteen inches.

The distribution in maple and beech, two shade endurers, is very regular, gradually decreasing from lower to higher diameters, showing their capacity to maintain regular development under the shade, therefore presenting all diameter classes regularly, while the birch, much more light-needing, exhibits great irregularity, only here and there finding sufficient light to develop.

PROPORTION OF HARDWOOD TREES OVER 12 INCHES, BY DIAMETER CLASSES.

	12 In.		14 In.		16 In.		18 In.		20 In.	
	No.	%	No.	%	No.	%	No.	%	No.	%
Maple	191	27.2	173	24.6	130	18.5	91	12.9	64	9.1
Birch	77	19.9	75	19.4	80	20.7	38	9.8	53	13.7
Beech	88	44.4	54	27.2	27	13.6	21	10.6	7	3.5
Total	356		302		237		150		124	
Per acre	13.6		11.3		9.1		5.7		4.7	
Per cent.	27.6		23.4		18.4		11.6		9.6	

	22 In.		24 In.		26 In.		28 In.		30 In.	
	No.	%	No.	%	No.	%	No.	%	No.	%
Maple	24	3.4	16	2.2	7	0.9	2	—	4	0.5
Birch	25	6.4	17	4.3	10	2.5	9	—	2	0.5
Beech			1	0.5						
Total	49		34		17		11		6	
Per acre	1.8		1.3		0.6		0.4		0.2	
Per cent.	3.8		2.6		1.3		0.8		0.4	

There were, as was to be expected, discrepancies between the estimate, the measurement and the final cut. The estimate gave 933 trees over twelve inches in diameter, with 40,269 cubic feet of wood, of which about 30 per cent. was log timber, equal to about 85,000 feet B. M., or about 90 feet per tree and less than 3,300 feet B. M. per acre. The measurement, in which each tree had to be counted and calipered, yielded 1,746 trees with 93,730 cubic feet, of which, however, only 21.5 per cent. was noted as log timber, equivalent to 140,000 feet B. M., 80 feet per tree, and 5,400 per acre. Of these 1,218 had been marked for cutting, with a volume of round 80,000 feet B. M. in logs. The final cut removed altogether 1,358 trees and the scale of logs on skids was 141,000 feet, of which 11,000 were softwoods, leaving for the hardwood stumpage alone 130,849 feet B. M., somewhat over 120 feet per tree, and 5,030 feet per acre.

The explanation of the difference of estimate, measurement and cut is of practical interest. In estimating it is impossible to count all the trees which in measuring are practically all found ; standing at a distance when estimating, not all defects can be seen, hence a larger log value is given to the trees, which by close inspection in measuring is avoided. It should be added that allowance for defects was based only on outer appearances. The larger output in logging is due to the fact that not only were the smaller logs figured in, but the trees cut much sounder material than their outer defects would indicate. Indeed it was surprising how much sound material could be cut from defective trees, the rot often stopping short where least expected. From this experience it would appear that an allowance of 40 per cent for unsoundness, which does not appear on the surface, as suggested by Mr. Gifford Pinchot in "The Adirondack Spruce" would be rather extravagant.

The following table exhibits the detail of results. The logs were cut down to 8 inches in diameter in lengths of 8 ft., 10 ft. 4 in., 13 ft. 8 in., and 16 ft., to comply with the requirements of the contract, more than one-half being 10 ft. 4 in. The scale is according to Scribner's rule, as used in the contract, which gives better measure for small logs.

The logs were measured as they were cut, by volunteer students, no allowance being made for defects ; the scaler's inspection reducing the scale for defects on skidways afterwards by 5.8 per cent. in quantity. These defects were found mostly in maple.

Roughly speaking, then, 88 logs of 57 feet to the log, or about 17 logs to the M. feet, and a little better than two logs per tree may be cut under the conditions named.

RESULTS OF A FELLING IN CULLED HARDWOOD FOREST.

Hardwoods.	No. of Trees.	No. of Logs.	Feet B. M.	Per Tree. Logs.	Per Tree. Ft. B.M.	Per Acre. Trees.	Per Acre. Logs.	Per Acre. Feet.	Percentic Distribut'n. Trees.	Percentic Distribut'n. Logs.	Percentic Distribut'n. Feet.
Maple	581	1,316	76,004	2.26	130.8	22.34	50.6	2,923	55.3	57.4	54.2
Birch	303	672	48,725	2.21	160.8	11.65	25.8	1,874	28.8	29.3	35.0
Beech	166	301	14,178	1.8	85.4	6.35	11.6	545	15.9	13.3	10.2
Total	1,050	2,289	*138,907	2.18	132.2	40.4	88	5,342	100.0	100.0	100.0
Scaler's correction.		2,278	130,849	2.17	124.6		87.6	5,032			

*The Doyle rule would have given only 115,952 feet, or 16½ per cent. less.

Softwoods.	No. of Trees.	Feet B.M.	Railroad Ties.	Pulpwood, Feet B.M.
Hemlock	118	7,300	404	
Spruce	140	4,300		
Balsam Fir*	29			
Aspen*	21			7,500
Total	308	11,600	404	7,500

*From a small strip of lowland.

From these figures it will have become evident that the hardwood forest of the Adirondacks—and this is a fair average sample—is not a great bonanza to work in after the merchantable pine and spruce is removed.

More than half the logs (1,206) were under 12 in. in diameter with 39,000 ft. B. M., showing what enormous waste in material (30 per cent.) results in the customary logging with a 12 inch standard.

The following table shows the number of logs of different diameters furnished by trees of different diameters, the diameters measured on the stump, about two feet above the ground. In this connection it may be noted that the majority of the older trees at least have rotten hearts in the lower portions, and hence it would be a waste to insist upon low stumps, unless reasonable assurance of soundness exists In most cases additional cordwood lengths have to be trimmed from the base of butt logs to come to a sound enough heart.

MATERIAL FURNISHED BY TREES OF DIFFERENT DIAMETERS IN LOGS BELOW 12″ AND OVER 12″ IN DIAMETER AT THE UPPER END.

Diam. of Trees.	No. of Trees.	Logs below 12″	Logs over 12″	Total No. of Logs.	Logs per Tree.	Per cent. of Logs below 12″	Per cent. of Logs over 12″
9	7	6	---	6	0.86	100	---
10	37	52	---	52	1.4	100	---
11	72	121	---	121	1.68	100	---
12	145	268	---	268	1.85	100	---
13	116	216	21	237	2.04	91.2	8.8
14	99	181	56	237	2.4	76.4	23.6
15	109	142	115	257	2.36	55.3	44.7
16	94	94	127	221	2.35	42.5	57.5
17	72	44	128	172	2.39	25.5	74.5
18	62	36	112	148	2.38	24.3	75.7
19	60	15	126	141	2.35	10.6	89.4
20	41	7	95	102	2.49	6.8	93.2
21	38	3	89	92	2.42	3.2	96.8
22	28	2	72	74	2.64	2.7	97.3
23	13	--	35	35	2.69	---	100
24	19	1	46	47	2.47	3.2	97.8
25	10	--	19	19	1.9	---	100
26	10	2	22	22	2.4	8.4	91.6
27	7	--	13	13	1.86	---	100
28	3	--	8	8	2.66	---	100
29	1	--	3	3	3.0	---	100
30	2	--	4	4	2.0	---	100
31	2	--	3	3	1.5	---	100
36	2	--	3	3	1.5	---	100
37	1	--	2	2	2.0	---	100

It will appear from this table that, of course, no trees of diameters of 12″ and less furnish any material of 12″ logs, that then the proportion of logs over 12″ rises until with trees of a 16″ diameter about half the logs are over 12″; then the increase of this class rises sharply to ¾ in the 17″ and 18″ trees, and after the diameter of 22″ is reached practically no more logs below 12″ are furnished, showing that the larger boles of these larger trees are of even taper and the heavy crown splits up from a full bodied bole.

The practical interest of the table lies in showing that where a 12″ standard for logs is to prevail, it would not be proper policy to cut trees below 17″ diameter, when at least 75 per cent. of the bole timber meets that standard, for otherwise the loss of material would be too considerable. A number of other practical deductions which would lead us too far in this report to detail may be, and will be, made from the table for the working plans of the forest.

Do Small Logs Pay?

It is claimed by contractors that it does not pay to move logs below the 12 inch diameter. This depends, to be sure, largely upon conditions under which the logging is performed, the manner of skidding and market conditions. A careful account kept during the sample cutting showed that the average cost per log under the conditions imposed by the care for young growth, and in summer, for cutting and skidding was 17.2 cents, the average log containing, according to the scaler's inspection, 57½ ft. It will be admitted that to cut and move the small logs costs somewhat less than to cut and move the large ones. Hence it may be fair to charge the 1,072 large ones, over 12 inches, with say 19 cents; the 1,200 small ones with 15½ cents; when the cost per M for the former will be $2.25, for the latter $4.80.

If, however, the latter in skidding are coupled in twos or threes or are cut so as to contain 65 feet instead of 32 feet in the average, the cost at once comes into more reasonable relation to that for larger logs; for then, even at the average rate of 17 cents per log, the cost per M. is $2.60.

In the case of the College Forest, where the material is to be fully utilized, the question could only be whether it pays better to hold out logs or to cut into cordwood, and the writer became convinced that, if in small logs 50 feet of sound material could be moved in one haul, it was more profitable to hold out logs; this requirement would be fulfilled by two 8 inch logs of 16 feet or two 8 foot logs of 10 inches diameter, provided they are absolutely sound.

Cordwood.

Besides the log timber there were harvested 499 cords of hardwood for retort and fuel purposes, taking all sound material to 3 inches in diameter, 19.2 cords per acre in 50 inch billets, equal to a round 20 standard cords, and one-half cord per tree in the average. In addition there were harvested 60 cords of brushwood, down to 1 inch diameter, which does not, however, represent all that could have been secured, and 190 cords or over 7 cords per acre of more or less doty wood from old logs and rotten trees, which may be utilized for limekiln purposes.

The 20 cords represent about 1,800 cubic feet of solid wood, while the 5,030 feet of logs represent only 790 cubic feet. In other words, the cordwood furnishes in cubic contents more than 2¼ times the amount of the logs per acre, and it is expected will furnish double the profit which the logs are expected to yield. Hence the great importance which has been given to the necessity of establishing a market for the cordwood.

Another lesson may be derived from this investigation. The 2,600 cubic feet of wood per acre, to which an addition of 800 feet for the culled spruce and the remaining material would be a very ample allowance—these 3,400 cubic feet have been produced by the virgin forest in an unknown period, but, as the age of the trees which furnish the bulk of the product indicates not less than 175 to 200 years—this volume would have been produced under common silvicultual methods in less than one-half the time, and probably, if pine and spruce are made the main crop, twice the amount of material could be harvested in one hundred years.

Other Hardwood Species.

Besides the three leading hardwoods to which this discussion mainly refers, there were found a few soft maples, ashes, elms and black cherries. The last three most valuable species which occur so sporadically in the virgin forest are the ones to which the forester should give special attention with a view of increasing their proportion ; they are perfectly at home and appear sporadically only because they are most intolerant of shade and hence in the struggle for life the shade enduring species in the long run occupy the ground, preventing the young progeny of the former from developing except in an occasional opening. It will be proper policy not only to leave all the seed trees of these species, which may be found in good condition, but to increase by artificial means the admixture of these more valuable species.

AGE AND GROWTH.

No systematic attempt was made to establish a relation of product to age, but enough counting of rings on at least ten trees of each species was casually performed to show the great variability of this relation and the great danger of generalizing too readily as to the capacity of species or to attempt the construction of yield tables, basing them on measurement in the virgin mixed forest with its infinite variety of conditions.

Of the sixty maples on which rings were counted, a diameter of 12 inches on the stump was reached by seven within the limits of age from 116 to 183 years. Ten trees reached a diameter of 16 inches in from 172 to 240 years, seventeen trees reached a diameter of 20 inches in 175 to 233 years, while the oldest and stoutest reached 28 inches in 280 years. This was a dominant tree and probably always had favorable position, making one inch in the average every ten years for a long time and probably representing the best that could be expected.

The few beech that were counted all indicate a rate similar to the maple, the best making one inch in 10 to 11 years, but they are not growing persistently, the largest one reaching a diameter of 24 inches. It should be stated, however, that this particular plot was rather poor in beech.

Birch,* on the other hand, showed a better rate in all the trees counted, namely mostly under ten years for one inch. The oldest and stoutest, 300 years old, measured 37 inches on the stump with a height of about 85 feet to the tip, furnishing, however, only two sound logs of 28 and 29 inches diameter with nearly 800 feet B. M. Another birch of 36 inches diameter and 90 feet height showed 275 rings with the following age relations :

Diam., inches	6	15	25	29	34	36
At age years	60	110	160	210	260	275

a steady increase of diameter at the rate of one inch every five or six years, during 100 years up to 160 years of age, the slower rate for the first sixty years, would indicate that at that age the tree was not in favorable position; for its capacity at a later age predicates a greater inherent capacity for the earlier years than it had a chance to develop.

While these figures cannot make any pretense of settling any question definitely, they in conjunction with the experience of the pro-

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*It should be stated that the birch referred to is always the Yellow Birch, *Betula lutea*, the only large timber birch of the region; so far no specimen of the Red or Cherry birch, *Betula lenta* has been observed on the College tract.

portionately larger amount of sound material furnished from a smaller number of trees, lend countenance to the expectation that the birch, under proper conditions, is at least in this part of the Adirondacks the fastest grower of these three leading hardwoods, and not, as would appear from the statements of Mr. Gifford Pinchot in "The Adirondack Spruce," the slowest. The rate of growth stated by him is for birch one inch in 20 years, for beech one inch in 13 years and for maple one inch in 16 years. The silvicultural characteristics of the birch, its greater need for light coupled with persistency of growth, also leads the forester to expect this greater rapidity of development over the other two more shade-enduring species.

Since in addition to this more rapid development the market value of birch is superior to that of maple—at least at present—the management will be justified in giving advantage in the reproduction to this species over the other two, relegating these to a secondary or tertiary position as desirable soil cover.

In the younger trees, from 2 to 4 inches in diameter with heights of from 25 to 50 feet—a spindly growth—maples showed variation in ages from 54 to 112 years, birches from 24 to 95 years, and beech from 25 to 63 years; spruce with heights ranging much lower, from 6 to 30 feet, ranged in age from 32 to 82 years, and this on spruces taken in fairly open stand and good average conditions, showing the great slowness of this species in height growth. This is also borne out in old trees in which it is only equaled by the hemlock.

A number of measurements to determine the volume accretion per cent. during the last ten years in older trees showed that maples and birches of 12 to 24 inches diameter were still growing at nearly 2 per: cent., but, to be sure, no account was made of the progress of decretion owing to rot at the heart.

SURVEY—STOCK TAKING—WORKING PLANS.

The topographical survey which was interrupted last year by the winter has been finished, except for control, which the forest manager is to perform next summer, and the map sheets have been drawn.

The survey has been made with an unusual degree of precision for reasons explained in my last report, the maps having been made on a scale of 1 : 4,800, good enough for any engineering work, road laying, railroad building, subdividing, etc., that may at any time become desirable. Reduced maps are appended.

A preliminary subdivision of the Axton District has been made according to the natural system, following the topography, to be revised during next summer's control work.

No further estimating of timber or stock taking has been done, since with the contract arrangement perfected, the necessity for this knowledge has become less pressing, in fact has lost its significance in part.

In this connection, I may be permitted to explain the absence of a so-called "working plan" in the restricted sense in which the term has found entrance in American forestry literature in which the main stress seems to be laid upon the determination of a felling budget, that is to say the amount which may be harvested either every year or at stated periods, so that after the period the same harvest may be made again, without decreasing the productivity of the forest. This budget, whether figured for an annual or an intermittent or periodic return, is a limitation on the use of the property by the owner. It requires him to curtail his present cut, to leave uncut certain portions, trees under certain diameters, which he might have cut now, for the sake of future revenues, for the sake of finding a new crop to be cut again earlier than if he had reduced the stock to a greater extent at the beginning. And it seems to be considered that such a determination of a felling budget is an inherent necessity, an essential condition of a forest management.

American System?

It has also been made to appear that European forestry methods require the determination of this budget for an annual management upon the principle of the so-called "sustained yield", that this sustained yield is not desirable to work for under American conditions, and hence an "American system of forestry" is necessary to be developed. The system advocated seems to resolve itself into culling out the more valuable species to a certain diameter as the lumbermen have done hitherto. This regulation of the felling budget by the diameter of the exploitable tree, one of the crudest methods, has been practiced for more than a hundred years in France in improved form and is now largely relied upon by the Indian Forestry Department, inaugurated and managed by German foresters.

As a matter of fact, European forest management does not necssitate such restriction in budget as a condition of a sustained yield, for, as the foremost modern German writer on the subject* explains; "In general a forest will be managed in sustained yield when care is taken to reproduce all the stands that have been cut, so that thereby the soil remains devoted to wood production." In other words, the sustained yield, *i. e.*, continuance of a crop, is secured simply by the *practice of silviculture.* And, later on, the same author, after having referred to annual and intermittent management, says: "A strict annual, sustained yield management is not always a necessity of forestry. The object of forestry can, therefore, not merely be to bring the forest to that condition."

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* Judeich, Forsteinrichtung.

This will suffice to show that the sustained yield in the sense of an annually or periodically equal return is by no means an inherent condition of forest management as taught by the Germans, although in practice they may have found it in most cases the desirable business policy under their social and market conditions, and, indeed, *it remains the ideal to be worked for always and everywhere.*

Ideals and Practical Limitations.

All man's endeavor, every business, has an ideal, but in practical application limitations of various kind prevent the attainment of the ideal; this holds true in technical fields as well as in the moral field. Nevertheless, consciousness of the ideal and endeavor towards its attainment as well as consciousness of the practical limitations make the successful manager.

The ideal of the forester, whether he be conscious of it in definite terms or not, is the so-called "normal forest", a forest so constituted, organized and regulated that every year the same number of trees or the same number of acres or the same volume of valuable material becomes ripe for harvest, yielding a steady revenue from year to year. An intermittent business is no more desirable in forestry, if carried on as a business, than in a grocery store.

It is evident what the conditions of such an ideal forest must be, in which ripe timber of a given age and amount can be cut annually and constantly. If we had determined that for our species and market and other conditions our timber may be considered as financially ripe at 80 years, *i. e.*, that it is most profitable to cut at that age—a certain diameter, supposably a function of age, might be substituted—then we should have one stand of 80 years ready for harvest, the next one of same size and condition 79 years old and so on, in order to bring one stand every year forever to harvest. These stands of different age, each varying by one year, represent the age classes of the ideal forest of which there must be 80 for a rotation of 80 years; and these age classes can be conceived either on separate areas or, as in the selection forest, all on the same area, so that trees of all ages are mixed together, yet in such proportion that every year the oldest (of 80 years) would furnish the same amount of harvest.

If we figure up the contents of all the age classes that must be present to furnish this annual budget, we would have the normal stock of such a forest, that is to say, we would have the wood capital which we must maintain in the business, in order to secure yearly the proper wood interest. The latter, of course, is represented by the annual accretion or increment that takes place on all the age classes, or what is the same, the accumulation of these annual increments in the oldest age class. The supposition is that this increment is and remains normal, *i. e.*, it represents the best possible accretion attainable by the species represented under the given growth conditions.

The ideal forest, then, is one that furnishes the largest possible sustained yield of highest possible value at least possible expense by its accretion, an ideal accretion, which is secured by ideal silviculture; the stock in such a forest is not reduced in quantity; it is a capital which remains permanently invested; the forest is perpetual, only the wood interest is removed.

Like all ideals, such a forest does not exist in actuality. Yet it is the one that the forester tries to approach, the guide for his operations, the business ideal. In the actual forest, he finds abnormalities, and it is his business policy and interest finally to approach normality or ideality as nearly as may be without losing sight of other practical considerations.

The solution of this problem is to be approached in the virgin woods, which grew without regard to man's economic needs, first by replacing the old, uneconomically growing stock, a dead capital, by a better crop, a live capital, by establishing ideal accretion.

When that has been done we may begin to determine annual or periodic felling budgets upon the basis of natural accretion, and upon the principle of sustained annual or periodic yield.

The procedure to determine this felling budget or permissible harvest is theoretically simple enough: ascertain the actual stock on hand, the actual annual accretion, and if these actualities are of normal amount, then the actual annual accretion is the proper felling budget. If, however, the actualities differ appreciably from the normal, *i. e.*, if there is more stock or less stock than necessary, or if the accretion is less than it could be, the budget must be increased or decreased until normal conditions are approximately secured. Practically, however, the ascertainment of these premises is by no means a simple operation, except that of the actual stock on hand. This is easily approximated by measurement or estimate. But the accretion or yearly increment, especially in our mixed old woods, is a matter which, for the present, withdraws itself entirely from being measured, with an expectation of a reasonable approach to the truth and to practical utility, for, as I have shown in another part of this report, not only is the relation between age and accretion in the virgin woods most uncertain, but as soon as we begin to cut we change the light conditions and the conditions of growth generally, and hence the rate of growth, and as we can only measure the past growth and use it as a prediction for the future, the prophecy is based on rather slim background and is hardly better than a guess.

We may produce figures and tables, but their value is problematical, and to attempt the construction of money value tables which are to show the money returns to be expected from such yields, can only be considered a farce, if it is supposed that any practical value attaches to them.

Especially is this true where we have to deal with an old virgin woods, in which decretion due to death or rot may offset the measured accretion, in which valuable trees and tree weeds are mixed in varying proportion. It should be noted that for such a selection forest, where light conditions are constantly varied by cutting, even the Germans, after a hundred years of attempt, have not been able to secure any satisfactory results or methods of measurement.

If there are unsurmountable difficulties in ascertaining actual accretion under such conditions of mixed, non-uniform woods, it is still more difficult to ascertain what the normal accretion and the normal stock should be. Hence, from mere practical considerations of the difficulty of furnishing the premises for such a budget calculation, the principle of the sustained yield in the sense of annual or periodic equalization must fall for our present conditions.

Nor is it a necessity or of practical utility, except as a desirable desideratum for the future—the distant future. For the present all that we should demand is a proper silviculture, namely to secure, whenever we harvest, as good a reproduction of our crop or rather of its most valuable parts as possible, to prevent all influences inimical to the satisfactory development of the crop.

Market Influences.

What the budget should be at present must be determined entirely by considerations of the market and our capacity to reproduce the cut over forest.

It is the *American market*, and only that, which makes the practice of forestry as a business different in the United States from that of Germany. And this, again, is due to the difference in density and distribution of population.

The German wood market is in most parts almost entirely a *local* market. Local consumption is steady, continuous, and ample enough to make a sustained annual yield the best business policy. A thorough utilization down to the small brush is possible through local consumption by the dense poor population. An *intensive* management pays best.

The American wood market is essentially *continental*. The harvest is not consumed where it is made, but is transported to centers of consumption. Cheap transportation over long distances is the key note of marketing it profitably. This requirement rules out in many districts any thorough utilization of the product. Inferior kinds, inferior parts of the harvest must be left unused. *Extensive* management is an unfortunate necessity in the exploitation of our natural resource on account of absence at the points of production of a local population to use the inferior material. Besides, the wealth of forest supplies at such points has produced lavishness in their use even in the resident population.

There is no normal home market to make the realization of the "normal forest" ideal at present desirable from business points of view; moreover, the characteristic mobility of American capital and business, including sawmills, also makes change of base and speculative treatment of forest properties—exploiting them and leaving to the future their restoration—preferable to intensive management. In addition, unfair systems of taxation discourage such management.

Unless, therefore, a definite, stable, continuous market requirement locally exists, as in the case of wood consuming factories, there is no inducement for private owners to attempt a forest management which restricts their felling budget. *Silviculture, i. e., attention to the reproduction of the crop, protection of the young crop and fuller utilization of the old crop is all that can be desired and expected.*

To create a local market by the establishment of local wood consuming industries is even for these first steps, in most cases, the first necessity, when the felling budget should be restricted, mainly by the possibility of profitable market and silvicultural needs.

Finally, a very important point must not be overlooked in discussing the question of sustained yield; namely that felling budget and area from which it is derived are necessarily in direct relation. The meaning of this self-evident truth is best illustrated by applying it to the conditions of the College Forest.

The felling budget for the College Forest has been based mainly upon the possibility of marketing cordwood or else on the annual requirement of a factory for such cordwood. We assume that it is to be 10,000 cords per annum, which will require the annual cutting over of 1,000 acres all told. At this rate, the 30,000 acre tract will furnish from its old stock supplies for thirty years, while new growth and additional removals of old growth may add five years more. At the end of 35 years there would have been established the first 35 age classes of a sustained yield management, but if the tract had been three times as large, it could have supplied the annual equal budget for 105 years and practically, by new growth, forever. In other words, an annual sustained yield management would have resulted at once simply by the proper relation of budget determined on the basis of market requirement to size of property.

Had, therefore, this development of market been foreseen and the State placed 100,000 acres instead of 30,000 at the disposal of the College, the business ideal of an annual sustained yield could have been approached at once.

Considerations like the above have determined the business policy of the College.

The working plan of the College Forest is not concerned with any consideration of the sustained yield, either annual or periodical. It unconsciously and deliberately offends this theoretically correct ideal, leaving it to a future generation to apply the principle. It is simply to remove, as fast as the market and practical considerations permit, the old crop and replace it by a crop of better composition and promise—to practice silviculture.

If silvicultural methods have been properly applied to renew the harvested forest in superior composition, if the old crop has been utilized to the fullest possible extent, and if this is done with due regard to economy, all has been done that can be done.

Three primary essentials must be the basis of an American system of forestry:

1. Better protection of forest property, including rational methods of taxation—a subject of legislation.

2. More thorough utilization of the forest crop,—a subject of wood technology and development of means of transportation and harvesting.

3. Silvicultural methods of harvesting, so as to produce a desirable new crop, or else artificial reforestation, if that is more effective and cheaper—the main concern of forestry.

At what rate our chickens will grow, if only we have them hatched, may be left to the future to determine, as well as the determination of the number that may be killed to advantage.

The details of the plan of procedure, then, in the College Forest will occupy themselves mainly with the desirable location of the fellings, the method of these fellings, the method of natural or artificial reproduction, and the like.

FOREST PLANTING AND NURSERIES.

Planting operations on burnt areas were continued this year, there being now ninety-five acres planted. The table on page 28 will give comprehensively a description of the different lots planted and their treatment.

The lots named sub 4 lie together in a continuous body near to and south-east of Axton, and are more or less of the same nature, namely, sandy hills with slash and weeds of varying density, with scanty aspen growth. It will be observed that the different lots were treated differently as regards the degree of preparation before planting. It is too early to have any judgment as to the effect of the treatment, except to state that the plantation made in 1899 on lot 1, without any preparation, planting the young trees with the hoe into the brush and weeds, the latter not very dense, makes a very satisfactory showing. Here stouter plants were used.

The weeds are mostly raspberries, blackberries and wild honeysuckle (Diervilla). By cutting and burning them once in the spring, as was done on the other lots, they seem only to thicken by throwing up new sprouts. A more systematic eradication by repeated mowings and in the summer season, when the rootstocks may be more or less exhausted, will be needed to be effective, if it is necessary at all. The eagle fern, which also covers patches of these lots, appears to be rather an advantage with its light shade, and possibly, with the use of stouter plants, any interference by the weed-growth may be altogether disregarded.

Further experiments into the question of most effective treatment of such waste lands are planned.

The cost and effect of weeding after planting is also under investigation. Some thirty acres of planted area were weeded with bush hook and pruning cleaver in the fall, at an expenditure of twenty-four labor days. The method of cutting lanes in the dense aspen and birch growth on West Hill will also be continued, making, however, the lanes wider, since the shade proves too great in the narrower lanes. The method of setting plants has been varied.

The first year's planting was all performed with the mattock. This year an iron planting dibble, the so-called Wartenberg iron, was also used. It is an iron shoe in the shape of a cone cut vertically,

BURNT AREAS PLANTED.

DESIGNATION.	ACRES.	CONDITION.	TREATMENT OF GROUND.	Approx. No. of Plants.	Date	ALIVE in 1900.
1. Stony Creek pasture	4¼	Abandoned pasture, partly slash	None	4,000	1899	80%
2. Roadside	¾	Grassy and brush	None	4,000	1899	70%
3. West Hill	3	Old burn with dense birch and aspen 10 to 15 years old	Lanes cut 4 to 6 feet wide, 3 to 5 feet apart	6,000	1899	30%
" "	16	Ditto	Ditto	20,000	1900	
4. Driving Camp Hill, Lot 1, south slope	10	Burn covered with small aspen and brush	None	35,000	1899	60%
Lot 2, east slope	4½	Ditto	None	2,500	1900	----
				4,500	1900	----
Lot 3, flat	4	Ditto	None	4,000	1900	----
Lot 4, west slope	12½	Ditto	Roughly cleared	12,500	1900	----
Lot 5, top of hill	6	Old open timber, hardwoods	None	6,500	1900	----
5. South Hill	9	Burnt slash	Thorough clearing and burning	9,000	1900	----
6. Meadow Hill	5½	Burnttimber and slash	Partial clearing	5,500	1900	----
7. Huntington Clearing	9½	Old burn, grassy and brush	None	32,000	1900	----
8. Cross Clearing	10	Grassy meadow	Cutting turf with hoe for planting spots	24,000	1900	----
Total	95			169,500	----	----

attached to an iron rod with crossbar, which thrust into the ground makes the hole, and a second thrust closes the hole, the plant having been inserted by the helper. It appears that with this instrument, which is adapted to light soils without much stone, twice the number of plants can be set in one labor day, namely, 1,600 per crew of two as against 800 with a grub hoe. This performance, with more experience in the use of the tool, can undoubtedly be improved.

The planting is done most expeditiously by squads of men working in pairs, one man making a hole either with dibble or grub hoe, the other setting the plant. This latter work could very well be done by boys; the absence of such cheaper labor must account for the great expense of the planting.

The plant material arrived partly in unsatisfactory condition; besides, the season opened late and arrangements for planting were somewhat deficient, so that the plants were late in getting into the ground. Planting began May 14 and continued to June 4. Not only was a considerable portion of the plant material lost before planting, but, in order to save in results of the labor in planting, in some areas two plants were set in one spot, to secure a larger proportion of survivals. The unusually favorable summer, however, resuscitated many almost hopeless cases, and the precaution of this double planting seems to have been useless. This manner of setting plants must explain the larger number of plants per acre used. As a rule, the distance of plants varied between five and nine feet, two to three steps apart, requiring in the average 900 plants to the acre, except where two were set in the same spot. On some of the first year's planting, fail places were reset.

Plant material in the first year, when stouter plants were used, bought from nurserymen in this country cost in the average $6.50 per M
at the plant hole, and labor in planting cost 3.40 " "
Total cost $9.90 " "

The second year, with smaller plants, cheaper kinds and the larger portion imported from Germany at considerably lower cost, the plant material, allowing for loss of plants in transportation and figuring only on plants actually used, has averaged:

	$1.85 per M.
Planting labor	3.00 "
Total cost	$4.85 "

less than half the cost of the previous year.

It is expected that when the home nurseries are in proper running order and planting crews better organized this cost can be still further reduced by twenty-five per cent.

In the two years, 169,500 seedlings were set out, averaging, therefore, 1,800 plants to the acre, of which, however, only 1,200 per acre may be estimated as alive. Regarding species used, the following list gives approximately the proportion of different kinds:

White Pine	65,500
Douglas Spruce	65,000
Norway Spruce	25,000
Scotch Pine	8,000
European Larch	4,000
Colorado White Fir	2,000
	169,500

The Norway Spruce has, so far, fulfilled most satisfactorily the expectation placed in it as a plant material for cheapness, rapidity of growth, endurance of summer drought and winter cold, and frost; Scotch Pine appears perfectly at home on the exposed and sandy slopes.

The use of the native spruce has been, so far, deferred for various reasons. In the first place its natural presence assures to it natural reproduction. Its artificial propagation has, so far, appeared expensive; cones are small and contain few seeds and a large proportion of poor ones; seedlings can hardly be had in the trade or are expensive; this year they are offered at $8.00 per M; the species seems of extremely slow growth, furnishing no better material than its rapid growing, cheaply propagated European congener. Nevertheless, it is proposed to collect seed and propagate the native spruce as soon as a good seed-year promises success.

Through the courtesy of the United States Department of Agriculture, Division of Forestry, the College received 20,000 Siberian Larch, the College paying the expenses of digging, packing and shipping. The shipment was made too late and only 400 of the plants retained vitality. These were set out in the Wawbeek Nursery, but a number of these also died during the summer. Altogether, the experience with larch of different kinds has been, so far unfortunate. A sowing of Siberian Larch in the Axton Nursery produced a very small crop of seedlings. Two shipments of Western Larch (Larix occidentalis) in two successive years proved a failure on account of sprouting during the journey. On the other hand, a small contingent of European Larch has flourished amazingly in nursery rows, and a sowing of ten pounds of seed of the same species has produced about 55,000 plants going into winter in good condition.

An experience of unexpected damage to plantations may be here recorded as a new one. The Cross Clearing plantation was made on an old, abandoned, dry, sandy meadow by removing the sod with the grub hoe in plats about one foot square and setting two plants, mostly Douglas Spruce, in the plat. A large number of these plants were eaten by the common grasshopper which infested the meadow, first taking the bud and then gnawing the bark from tip to base. The damage was done so quickly that its progress was not observed. The State Entomologist visited the plantation with a view of studying possible remedies, but arrived too late.

Nurseries.

To furnish the large amount of plant material required in the reforesting of the burnt and cut over areas, two nurseries have been established; the one in Axton, which was reported upon last year, contains 36,000 square feet of useful area (excluding roads, etc.), the other in the Wawbeek District in the woods, containing nearly a like amount, the total area occupied being twice as large.

At the end of the season the Axton Nursery contained in all 425,000 useful plants, of which 150,000 are ready for transplanting into the woods, 240,000 either transplanted or to be transplanted in nursery rows and 35,000 seedlings to remain in seedbeds another year. This number is the survival of probably not less than one and one-half to two million germinated seeds, drought, frost (on June 30, 1899, frost killed potatoes!) and frost heaving, sparrows and other birds, and grasshoppers all combining to reduce the numbers. Nevertheless, this plant material costs still less than it could be bought for in nurseries.

In the Wawbeek Nursery, which was only established in the spring, 110 pounds of seed were sown, comprising White Pine, Norway Spruce, Nordman Fir and European Larch. The sowing was not done until the second and third weeks in June. An estimated number of 566,000 seedlings resulted, the White Pine coming most poorly. White Pine seed was poor and expensive last year; besides it has the bad habit of "lying over," some of the seed germinating only the second year: in the Axton Nursery, about fifty per cent. of the seed did not germinate unlil the second year. In addition, the squirrels found out that a more toothsome food than spruce seed could be had, and leaving the beds sown with the cheaper spruce seed untouched, systematically dug up row after row of the White Pine seeds, and this in spite of a coating of red lead applied to the seed, which apparently had no effect; the damage was mostly done before discovered and hence no protective measure could be taken.

In addition, the nursery contains some 54,000 transplants of the year's purchase which remain over from last spring's planting and are ready for use.

An interesting experiment into the hardiness of Chestnut, Chestnut oak and two species of Hickory from North Carolina has been instituted through the courtesy of the Biltmore Nurseries of the Vanderbilt Estate, which kindly placed 1,400 plants of these species at the disposal of the College. The plants have been set out both in Axton, on the exposed, sandy site, and in the protected site and heavier soil of the Wawbeek Nursery. The Hickories seemed to suffer during the summer, but the Oak and Chestnut came into winter in good condition. Some of the plants have been covered, others left uncovered for the winter.

Another similar experiment in acclimation with Japanese tree-seeds was instituted at the instance of the United States Department of Agriculture. These seeds were sown in cold frames, as well as other Japanese tree seeds received directly from Japan, through the Director of the Forestry School at Komaba, in exchange for native seeds. Some forty species are represented, most of which sprouted and with few exceptions are still alive.

There is, so far, no experience in this region as to the needs and dangers to be avoided in growing seedlings, and hence it will have to be paid for. The greatest loss experienced was due to frost heaving, which was most unexpected in the loose, sandy soil which is found at Axton. It occurred in April and was not at once discovered. A number of the heaved plants, some 5,000, which had been out quite a while, were reset and recovered entirely, causing regret that more had not been so treated. Since in three successive years killing frosts occurred in the months June, July and August, by which even potatoes were killed, there will be considerable apprehension for the young seedlings. They are, of course, constantly kept under screens. Whether or not it is desirable to give a frost cover will be found out this winter: a small trial having been made last year, when the few beds so covered came out decidedly better looking, For such cover, dry leaves, fern straw, balsam boughs and moss have been used, also single and double screens. For comparison in each covered bed some rows are left uncovered. So far, only birds, grasshoppers and squirrels have been found out as enemies against which provision must be made.

BUILDINGS.

When it had been decided that the junior and senior classes were to spend the spring terms at Axton, the need of better accommodations was recognized, and it was decided to build a College Lecture Hall and Dormitory of simple construction, plans for which were drawn. The failure of the Legislature, however, to appropriate the funds asked for necessitated the abandonment of this plan. By rebuilding an old warehouse and chickenhouse, a temporary makeshift has been made for a library and lecture hall, and other makeshifts for housing the students and professors have been made in the boarding house and cottages. As long as the numbers remain small, such makeshifts may answer, even for a State institution, but just as necessities call for enlargement of accommodations for the College at Ithaca, proprieties call for improvement at Axton.

Considerable improvement has been made in appearances at Axton, by removing old stables and barns, rebuilding, fixing up and painting the other buildings, at an expenditure of round $3,750. Yet further expenditure of at least $8,000 more will be necessary to place the establishment on a proper and decent basis.

The establishment at Cross Clearing, (now called "Foresters" by the Post Office Department making it a post office,) which will be the headquarters during a number of years for logging and planting operations, has been enlarged by a small office building, a smithy and additional barn room, so that now a crew of from 60 to 90 men and the necessary horses can be accommodated. The cost of the whole establishment, substantially built for permanent quarters, has been round $2,250.

It is proposed to conduct this establishment as a model camp, furnishing better accommodations than is usual or possible in the ordinary temporary logging camps, in order to attract a better class of workmen. Being centrally located with the railroad passing it—the early winter prevented the completion of the railroad to the camp as contemplated—it will be possible to take the crews to and from their work by handcars, saving time and energy or avoiding the establishment of temporary camps in different parts of the tract.

ORGANIZATION.

As at present organized, the management and accounts of the College and College Forest are kept strictly separate, except that the direction of operations in the College Forest remains in the hands of the Director, who receives weekly reports and makes occasional visits of inspection.

A resident forest manager is in charge of all the technical work, as the marking of trees for felling, and supervision of the felling, planting and nursery work, conducting of experiments, collecting data and statistics, and making reports on the work. Mr. E. Hagger, a forester of experience, who has had his professional education in Switzerland, occupies this position.

The purely business arrangements, such as the hiring and detailing of labor, the provisioning and outfitting, care of buildings and property, purchase and sale of materials, as well as the book keeping and scaling are in charge of the Superintendent, Mr. Thomas W. Collins, whose long experience in logging camps and offices has made him specially familiar with these duties. Assistants, guards, etc., are hired as needed by the Superintendent with the approval of the Director. A logging foreman of experience is in charge of the crew and camp, supervising the labor.

The book keeping is done by the Superintendent, monthly trial balances being sent to the Director as well as weekly reports of all expenditures and work done. Only unavoidable payments of limited amounts are made by the Superintendent directly from a limited fund placed in the hands of the Director and refunded by reimbursment vouchers. Bills are vouchered twice a month, as far as possible—payrolls on the 1st, bills for materials on the 15th of the month. The bills are audited and authorized by the Director and entered into a voucher record which shows continual balances on hand and serves as a check on the book-keeping. Vouchers are then paid by the Treasurer of the University, and after auditing by the proper committee of the Trustees, are forwarded to the Comptroller at Albany as vouchers against the sums withdrawn from the State Treasury.

A monthly estimate of the expenditures which will become necessary during the month is submitted by the Director with a statement of unused balances remaining from the previous month, and the amount authorized by the Comptroller to be drawn is placed in a specially designated bank for use of the Treasurer.

The income is reported monthly to the Comptroller as placed in the bank, and is drawn against, as needed, in the same manner as the working fund.

The general policy of the management is in charge of a Forestry Council, consisting of the President, the Treasurer, one Trustree, the Director and one member of the Faculty. The Council passes upon the recommendations of the Director, and approval of the Board of Trustees is required for all actions not of a routine nature.

The boarding-house and farm at Axton have, so far, been rented at a merely nominal sum, the students and College officials paying board at stipulated rates.

FINANCIAL STATEMENT.

In the following financial statement the account is laid for all appropriations from the beginning of the College, in order to give a complete insight into the financial status to the present.

The College year opening on or near October 1, the account is given for the appropriations of the first two years to September 30, the new annual appropriation becoming available with the last quarter of the calendar year.

FINANCIAL STATEMENT OF COLLEGE ACCOUNT FOR TWO YEARS ENDING SEPT. 30, 1900.

Appropriations for two years		$20,000.00
Salaries	$13,500.00	
Lecturers	250.00	
Clerk hire	399.85	
Stationery and Printing	1,011.89	
Library and Demonstration Material	1,887.60	
Laboratory and Equipment	470.05	
Contingencies*	2,180.11	
Balance unexpended	300.50	$20,000.00

For the College Forest two statements are given, the first to June 30, 1900, when the original appropriation of $30,000 was exhausted, this amount having been expended mainly as additional investment to place the property in working condition. With July 1 the second appropriation, which it is the policy of the management to use in the nature of a working fund, restricting expenditures, as far as possible, to the income, was drawn upon, and hence a new book account was begun, the balance of which appears in statement.

The income derived from expenditures of the previous year is all credited to this account. There is also to the credit of this account on hand in the woods, cut, ready for delivery at the end of the quarter, according to estimate, at least 1,500,000 feet of logs and 3,000 cords of wood, besides other materials.

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*Includes expenses in locating College Forest and Forest expenses for the first year in part.

FINANCIAL STATEMENT.

A. COLLEGE FOREST ACCOUNT FOR TWO YEARS ENDING JUNE 30, 1900.

Appropriation		$30,000.00
Maintenance:		
Salaries and services	$2,706.36	
Traveling	478.07	
Freight and postage	417.78	
Team hire and feed	1,006.54	
Sundry accounts	1,934.82	
Equipment	4,020.11	
Buildings	5,446.45	
Survey and stock taking	5,347.35	
Improvement:		
Nurseries	1,694.98	
Forest planting and clearing	2,244.48	
Roads and opening up	1,963.43	
Wood cutting	2,739.63	$30,000.00

B. COLLEGE FOREST ACCOUNT FOR TWO QUARTERS ENDING DEC. 31, 1900.

Appropriation		$30,000.00
Income account		7,729.98
Maintenance	$2,891.94	
Improvement:		
Nurseries	1,473.51	
Forest planting and clearing	291.69	
Wood account	212.66	
Roads	201 50	
Equipment	167.42	
Building	595.49	
Survey	559.65	
Logging account	16,747.40	
Balance unexpended	14,678.72	$37,729.98

Maintenance account contains a charge of $1,015.05, which the College was obliged to pay for taxes which had accrued on the property before the same was purchased and deeded to the University, in order to avoid sale of the property for arrears. This charge is recoverable by the Forest Preserve Board as purchasers from the grantee.

The cost of Logging account, which involves the furnishing of logs and cordwood under contract, is kept separate, as far as possible.

C. College Forest Account.

Income Statement.

By rents	$ 295.00
By students' fees	715.00
By wood sales (credit Improvement account)	1,054.72
By contract work on roads, "	634.80
By students' board (Maintenance)	30.12
By sundries, "	184.99
By logging contract, part payment	3,300.00
By reimbursements :	
Forest Preserve Board (Maintenance) (Fire fighting).	1,035.00
State Surveyor's Board, "	265.00
Duties on seedlings (Improvement)	215.98
Total	$7,729.98

During the spring of 1900, as a matter of accommodation, the crew of the College was employed on a piece of work for a neighbor, the bill amounting to $616.10 ; men and provisions being paid for directly, this item does not appear in the statement.

SUMMARY.

Summarizing again briefly, as in former reports, the contents of this report and the needs of the College, the following points may be noted :

1. The College is satisfactorily progressing with a student roll of 25, and continues to be useful to other departments of the University.
2. The practical work at the College Forest for the junior and senior classes has proved a most satisfactory institution.
3. The business policy of the College Forest is fully established, the market for the old crop having been secured and logging operations on an adequate scale for its harvest having begun.
4. The expectation of making the experiment self-supporting from the start by means of this harvest promises to be realized.
5. Planting operations have been continued, 95 acres having been treated, and preparation for increased activity in that direction made by the establishment of nurseries, details of which are given.

6. An analysis of the results of a sample felling brings out the basis for calculating yield and cost of logging of culled hardwood lands in the Adirondacks.

7. An explanation is given for the absence of elaborate measurements to determine a felling budget according to relations of growth to age, as prescribed in so-called "working plans."

The needs of the College may be briefly summarized as follows :

1. A building to house the College at Cornell University.
2. A dormitory and lecture rooms at Axton.
3. An appropriation of $12,000 to carry on the work of the College, the slight increase to permit investigations and experimental work.
4. An increase of the working fund to $50,000, as originally asked for, for reasons given in this report, with the understanding that this appropriation is to be managed only as a permanent working capital.

Respectfully submitted,

B. E. FERNOW,

Director.

CHAPTER 419, LAWS OF 1900.

AN ACT

To amend an act entitled "An act to promote education in forestry, to encourage and provide for the establishment of a college of forestry at Cornell university, and making an appropriation therefor," being chapter one hundred and twenty-two of the laws of eighteen hundred and ninety-eight, relating to the disposition of proceeds from the sale of timber and otherwise.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

SECTION 1. Section seven of chapter one hundred and twenty-two of the laws of eighteen hundred and ninety-eight, entitled "An act to promote education in forestry, to encourage and provide for the establishment of a college of forestry at Cornell university, and making an appropriation therefor," is hereby amended so as to read as follows:

§ 7. All sums received by the university from the sale of timber or otherwise, under this act, shall be deposited on the first day of each month to the credit of Cornell University in such bank or banks as may be designated by the comptroller for that purpose, Each bank so designated shall file with the comptroller a bond in an amount and on conditions approved by him. The treasurer of Cornell University shall on or before the fifth day of each month file with the state comptroller a verified statement showing the amount of money so received and deposited when, from whom and for what received, and the day on which the deposit was made, and said statement shall have endorsed thereon a certificate of the proper officer of the bank that such deposit has been made. The money so deposited may be drawn by the treasurer on his check or draft countersigned by the comptroller for any amount included in an estimate approved as herein provided. The director of the New York State College of Forestry of Cornell University shall on the first day of each month file with the comptroller an estimate and detailed statement of all moneys that will in the judgment of such director be required in that month for the administration of the trust committed to Cornell University under this act in connection with the forest lands. The comptroller may revise and reduce the estimate and shall fix the amount which may be drawn thereon. At the end of the period for which the trustees of Cornell University hold title to said forest lands they shall render a full account of said fund to the comptroller of the state of New York, and all balances, if any then remain, shall be paid over to the state treasurer.

§ 2. This act shall take effect immediately.

CORNELL UNIVERSITY

DEPARTMENTS AND COLLEGES

GRADUATE DEPARTMENT

Degrees, A.M., Ph.D., etc.

ACADEMIC DEPARTMENT

Degree, A.B.

COLLEGE OF LAW

Degree, LL.B.

MEDICAL COLLEGE

Degree, M.D. New York City and Ithaca

NEW YORK STATE VETERINARY COLLEGE

Degree, D.V.M.

COLLEGE OF AGRICULTURE

Degree, B.S.A.

NEW YORK STATE COLLEGE OF FORESTRY

Degree, B.S.F.

COLLEGE OF ARCHITECTURE

Degree, B.Arch.

COLLEGE OF CIVIL ENGINEERING

Degree, C.E.

SIBLEY COLLEGE OF MECHANICAL ENGINEERING AND MECHANIC ARTS

Degree, M.E.

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U. HOLZER
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BOSTON, MASS.